Predicting the impact of long-term temperature changes on the epidemiology and control of Schistosomiasis: A mechanistic model

Author(s): Mangal TD, Paterson S, Fenton A
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Abstract:

Background. Many parasites of medical and veterinary importance are transmitted by cold-blooded intermediate hosts or vectors, the abudance of which will vary with ambient temperatures, potentially altering disease prevalence. In particular, if global climate change will increase mean ambient temperature in a region endemic with a human pathogen then it is possible that the incidence of disease will similarly increase. Here we examine this possibility by using a mathematical model to explore the effects of increasing long-term mean ambient temperature on the prevalence and abundance of the parasite. Schistosoma mansoni, the causative agent of schistosomiasis in humans. Principal Findings. The model showed that the impact of temperature on disease prevalence and abundance is not straightforward; the mean infection burden in humans increases up to 30°C, but then crashes at 35°C, primarily due to increased mortalities of the snail intermediate host. In addition, increased temperatures changed the dynamics of disease from stable, endemic infection to unstable, epidemic cycles at 35°C. However, the prevalence of infection was largely unchanged by increasing temperatures. Temperature increases also affected the response of the model to changes in each parameter, indicating certain control strategies may become less effective with local temperature changes. At lower temperatures, the most effective single control strategy is to target the adult parasites through chemotherapy. However, as temperatures increase, targeting the snail intermediate hosts, for example through molluscicide use, becomes more effective. Conclusions. These results show that S. mansoni will not respond to increased temperatures in a linear fashion, and the optimal control strategy is likely to change as temperatures change. It is only through a mechanistic approach, incorporating the combined effects of temperature on all stages of the life-cycle, that we can begin to predict the consequences of climate change on the incidence and severity of such diseases. © 2008 Mangal et al.

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Resource Description

Exposure :

weather or climate related pathway by which climate change affects health

Temperature

Geographic Feature:

resource focuses on specific type of geography

Freshwater

Geographic Location:

resource focuses on specific location

Global or Unspecified

Health Co-Benefit/Co–Harm (Adaption/Mitigation):

specification of beneficial or harmful impacts to health resulting from efforts to reduce or cope with greenhouse gases

A focus of content

Health Impact:

specification of health effect or disease related to climate change exposure

Infectious Disease

Infectious Disease: Foodborne/Waterborne Disease

Foodborne/Waterborne Disease: Schistosomiasis

Mitigation/Adaptation:

mitigation or adaptation strategy is a focus of resource

Adaptation

Model/Methodology:

type of model used or methodology development is a focus of resource

Outcome Change Prediction

Resource Type:

format or standard characteristic of resource

Research Article

Timescale:

time period studied

Time Scale Unspecified

Vulnerability/Impact Assessment:

resource focus on process of identifying, quantifying, and prioritizing vulnerabilities in a system

A focus of content